Graywater Application for Army Installations – Introducing a New Guidance Document

Environment, Energy & Sustainability Symposium
Denver, CO
4-7 May 2009

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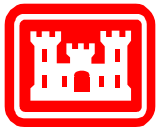


Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
MAY 2009		**00-00-2009 to 00-00-2009**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Graywater Application for Army Installations - Introducing a New Guidance Document	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Corps of Engineers,Construction Engineering Research Laboratory (CERL),Champaign ,IL,91826**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 4-7 May 2009 in Denver, CO.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**32**	

What Are PWTBs?

- Public Works Technical Bulletins
- Sponsored by USACE HQ
- Variety of Subjects
- Available through Whole Building Design Guide
- Accessible at:
- http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215
- May have to use Alternate Path – CCB, Army/COE, then PWTB

PWTB Contents

- Definitions
- Regulatory Review
- Overview of Graywater
- Types of Systems
- Potential Military Installation Applications
- Summary

Military Installation Water Drivers

Water Resources

- Increasing Water Quantity and Quality Concerns
- Drought
- Climate Change

Legislative and Executive Drivers

- Clean Water Act
- Energy Policy Acts
- Executive Order 13423 - All Installations Must Reduce Consumption 2% Annually

Defense/Army Strategies and Policies

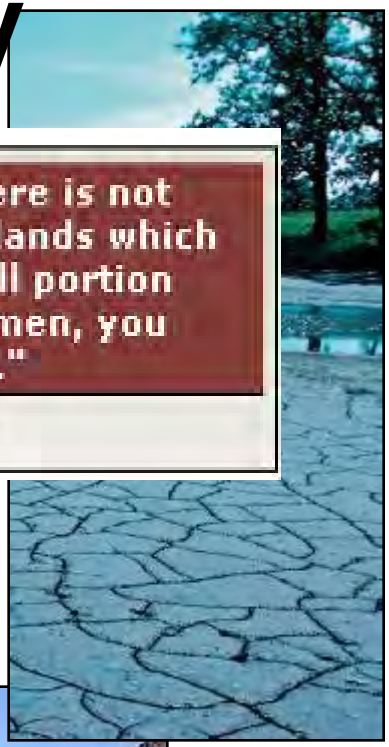
- Strategic Plan for Army Sustainability
- Army Strategy for the Environment
- 2005 Army Energy and Campaign Plan for Installations
- Installation Sustainability Plans - Water Conservation Goals
- LEED (Leadership in Energy and Environmental Design) USGBC
- Federal Best Management Practices

Decreasing Supply

- Over Withdrawal
- Climate Change
- Cost and Financing
- Quality Degradation

"I wish to make it clear to you, there is not sufficient water to irrigate all the lands which could be irrigated, and only a small portion can be irrigated. I tell you, gentlemen, you are piling up a heritage of conflict."

-- Maj. John Wesley Powell, 1893



Lynn Betts, NRCS

Rocky Mount Reservoir, NC (2007)

Lake Mead, 2003
(Las Vegas Valley Water District)

FEMP Best Management Practices

1. Water Management Planning
2. Information and Education Programs
3. Distribution System Audits, Leak Detection and Repair
4. Water Efficient Landscaping
5. Water Efficient Irrigation
6. Toilets and Urinals
7. Faucets and Showerheads
8. Boiler/Steam Systems
9. Single-Pass Cooling Equipment
10. Cooling Tower Management
11. Commercial Kitchen Management
12. Laboratory/Medical equipment
13. Other Water Use
14. Alternate Water Sources

Other Water Use/Alternate Water Sources Options

What can be done to increase available supply?
How can we efficiently use what's available?

- Water Reuse
- Desalination
- Produced Water
- Rainwater Harvesting
- Ground Water Recharge
- **GRAYWATER REUSE**
- Sewer Mining

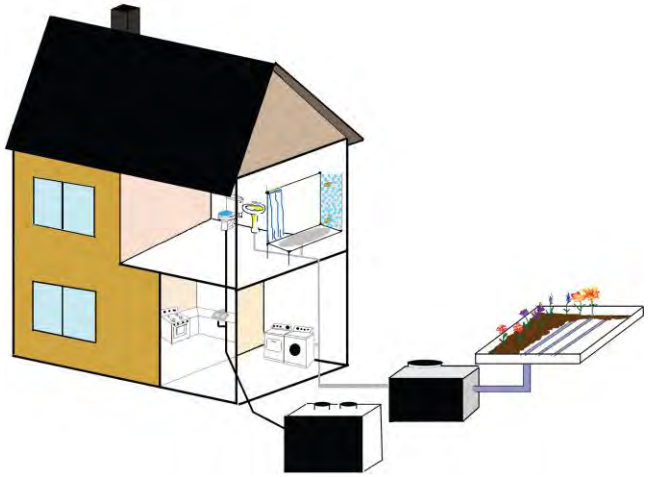
Army Policy

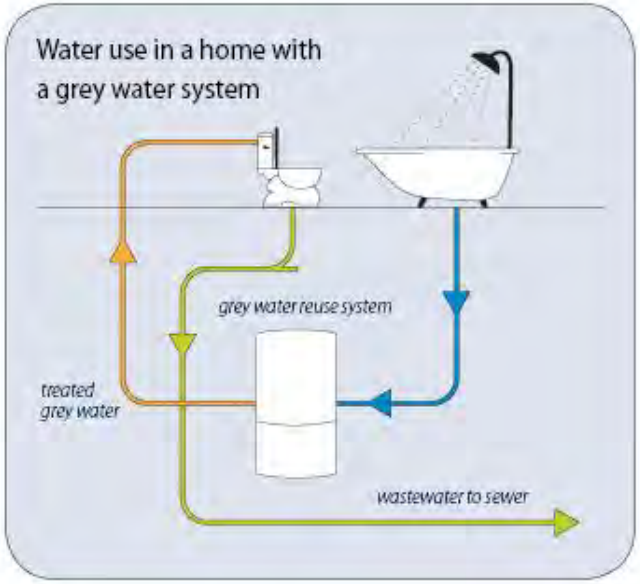
- **Where LCC effective, reclaimed or treated recycled water will be used for irrigation and other non-potable uses.**

- **Gray-water or untreated effluent from laundry, dishwashing, and personal hygiene/bathing will not be recycled or reused as part of a United States Green Building Council (USGBC) sanctioned program for a LEED (Leadership in Energy and Environmental Design) credit without approval from IMCOM.**

Definitions

Graywater = Greywater = Gray Water = Grey Water





Blackwater

Toilet, Kitchen Wastewater

Reclaimed Water

Wastewater Treated to High Standards at Municipal Treatment Facilities, Delivered to Customers via “Purple Pipe” System

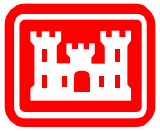
History

- **Long History in Arid Parts of the U.S.**
  - Common in Rural Areas
  - Technically Still Illegal in Many Places
  - May Get 40 Gallons per day per Person
  - Technology to Use – Highly Variable
    - Rinse Water from Washer for Next Load
    - Direct Discharge to Irrigation
    - Or Complex Treatment
    - Living Systems – Water Plants and Sand Filtration
    - Often Minimal Treatment then Underground Irrigation System
- **Many Commercial Package Plants**
  - Filtered, Disinfected Product – Fairly Expensive

What People Think

Graywater Sources and Percent of Household Flow

Source	Percent	Category
Toilet	40	Blackwater
Kitchen waste	10	Blackwater
Misc	5	Graywater
Laundry	15	Graywater
Bath/Shower	30	Graywater



Quality of Graywater

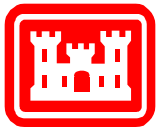
- **Biological**
  - Microorganisms
- **Chemical**
  - Dissolved Salts – sodium, nitrogen, phosphates, chloride
  - Others – oils, fats, soap, detergents
- **Physical**
  - Soil
  - Lint

Compared to Combined Wastewater

- Lower in BOD
- Lower in Suspended Solids
- Lower in Nitrogen
- Lower in Phosphorous
- More Alkaline
- Higher in Salts

Controversy?

- Why? Potential Health Threat
- No Cases Reported
- No National Guidelines
- More States Becoming Proactive in Encouraging Use
- Lobbying at Federal Level for Recognition for Use
- Guidelines Vary Internationally

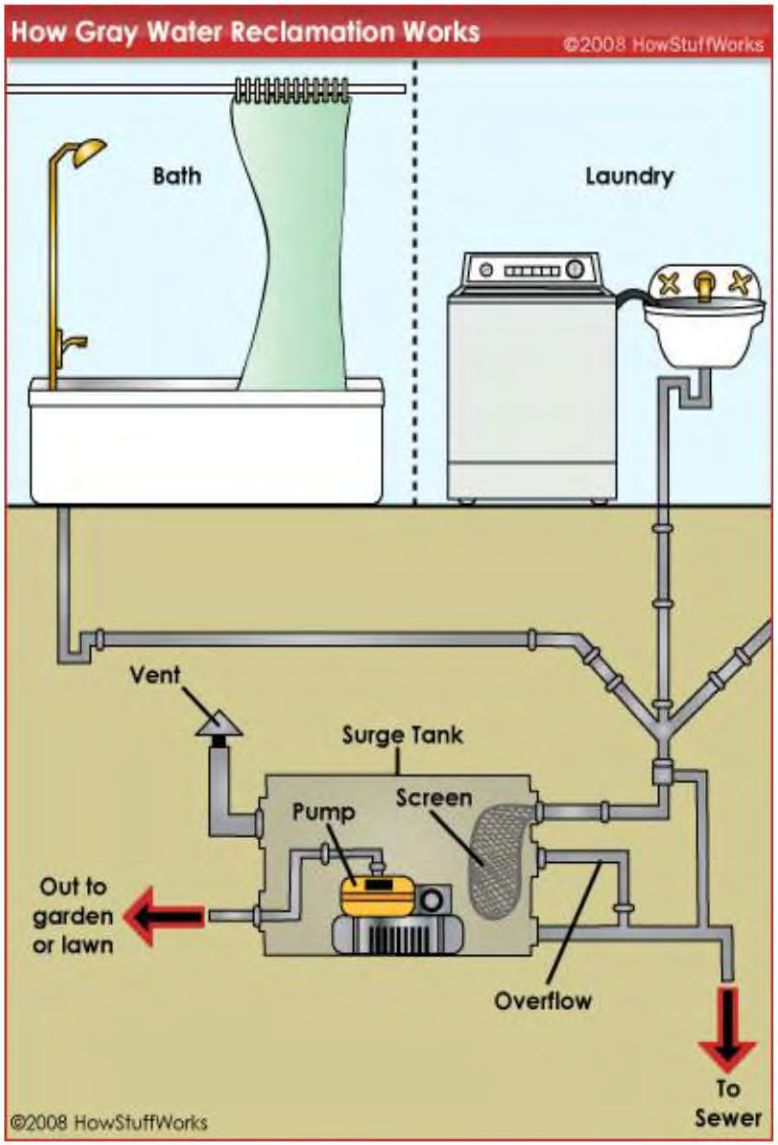


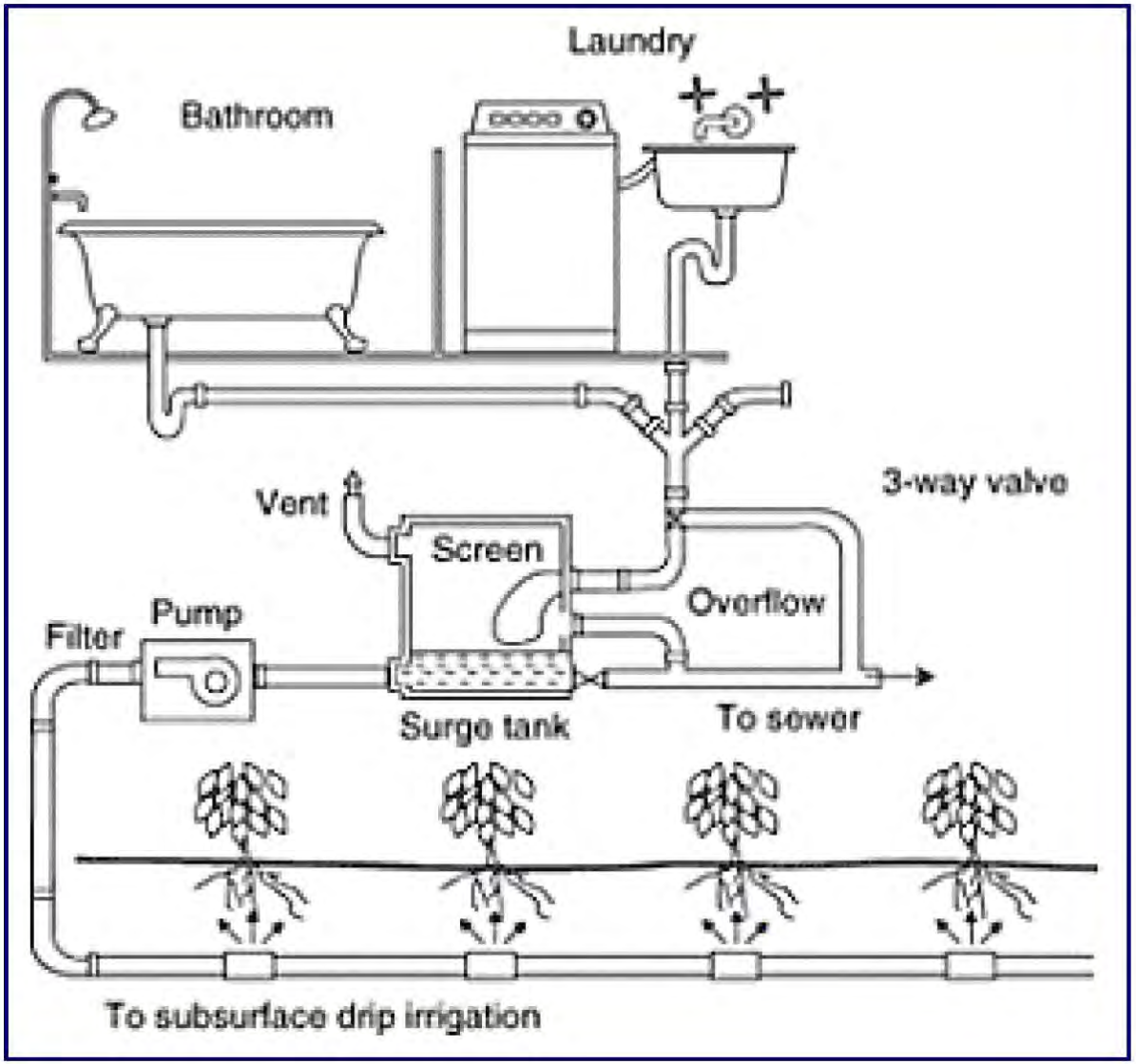
California Greywater Policy Data and Calculations

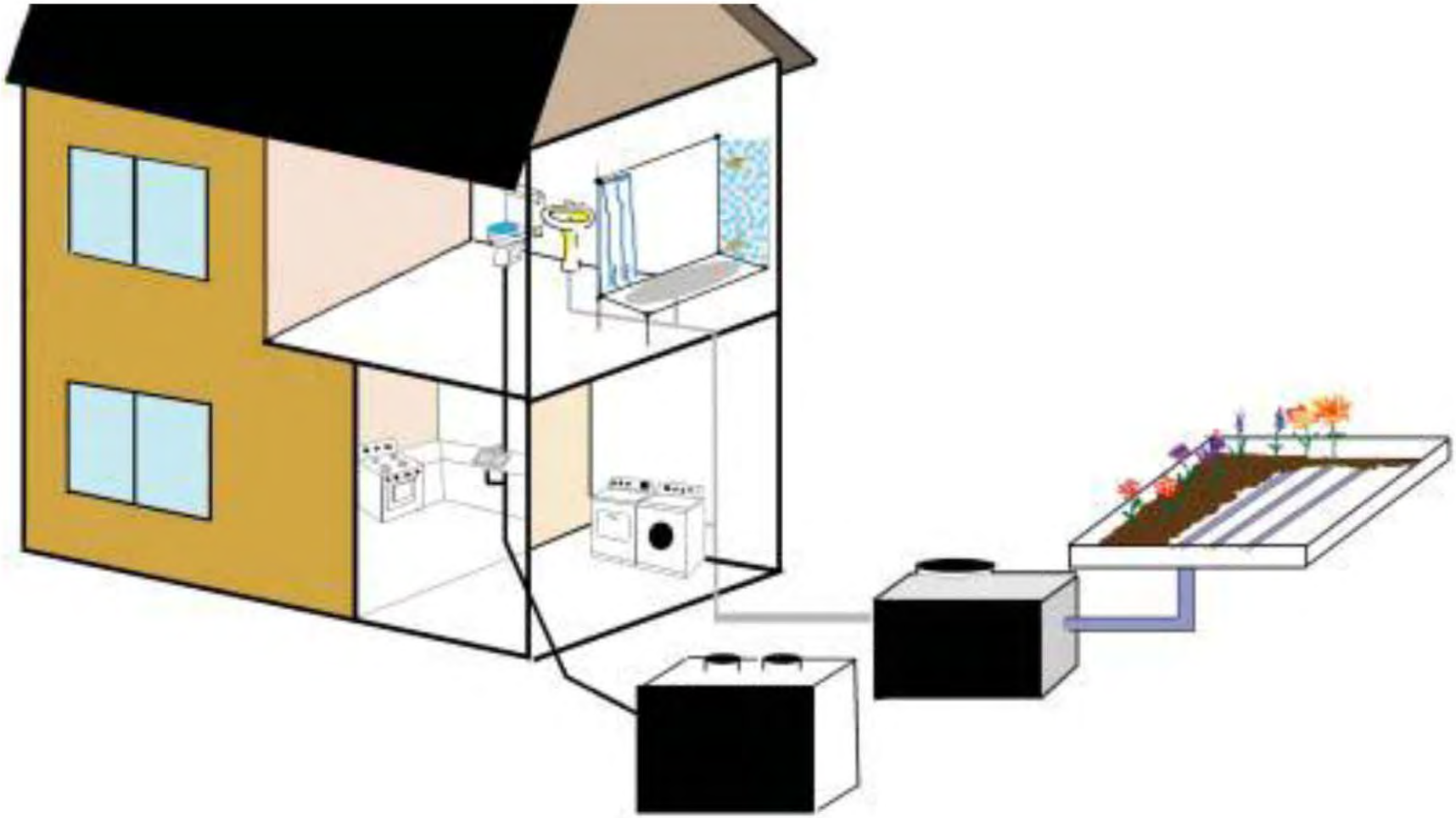
Datum	What	Date	Source	URL, comment
Greywater system exposure in California				
36,553,215	Population of caliornia	2007	US census bureau	http://quickfacts.census.gov/qfd/states/06000.html
13.9%	Households with greywater systems	1999	Soap and Detergent Manufacturer's Association Graywater	p. 14 http://www.sdascience.org/docs/Graywater_Habits_&
5,080,897	Greywater users	2009	Calculation; population * percent greywater users	extrapolation from 1999
2.87	People per household	2000	US census bureau	http://quickfacts.census.gov/qfd/states/06000.html
1,770,347	Greywater systems	2009	Calculation; greywater users / people per household	(this assumes the proportion of greywater use has not chan
System user years-CA		*Note: This is a back of the envelope-type calculation; the point is still valid if it is off by a factor of two or four*		
5,080,897	Greywater users	2009	from above	
10.0%	Households with greywater systems	1950	Estimate; in general, older infrastructure has more greywater use, approaching 100% with rural 70+ year old buildings	
10,586,223	Population of caliornia	1950	US Census Bureau	www.census.gov/dmd/www/resapport/states/california.pdf
1,058,622	Greywater users	1950	Calculation; population * percent greywater users	
3,069,760	Average number of greywater users	1949-2009	average of 2009 and 1950 greywater users	
60	Years from 1949-2009		calculation	
184,185,576	System-user-years of greywater exposure, not counting neighbo		caculation; average greywater users * years	
Greywater system exposure in United States				
303,824,640	Population of US	2008	CIA estimate	https://www.cia.gov/library/publications/the-world-factbook/p
7.0%	Households with greywater systems	1999	Soap and Detergent Manufacturer's Association Graywater	http://www.sdascience.org/index.php?option=com_content&
21,267,725	Greywater users	2009	Calculation; population * percent greywater users	extrapolation from 1999
2.59	People per household	2000	US census bureau	http://quickfacts.census.gov/qfd/states/06000.html
8,211,477	Greywater systems	2009	Calculation; greywater users / people per household	extrapolation from 1999
System user years-US		*Note: This is a back of the envelope-type calculation; the point is still valid if it is off by a factor of two or four*		
21,267,725	Greywater users	2009	from above	
10.0%	Households with greywater systems	1950	Estimate; in general, older infrastructure has more greywater use, approaching 100% with rural 70+ year old buildings	
152,271,417	Population of US	1950	NPG historical data	http://www.npg.org/facts/us_historical_pops.htm
15,227,142	Historic greywater users	1950	Calculation; population * percent greywater users	
18,247,433	Average number of greywater users	1949-2009	average of 2009 and 1950 greywater users	
60	Years from 1949-2009		calculation	
1,094,845,995	System-user-years of greywater exposure, not counting neighbo		caculation; average greywater users * years	
Reports of graywater-transmitted illness in US				
0	Reports of greywater-transmitted illness		18 years of greywater policy discussion, Letter from CDC	
400	People struck by lightning in the US, per year	2008	NOAA lightening safety	http://www.lightningsafety.noaa.gov/medical.htm
344	People drowned in bathtubs	2005	National saftey council	http://www.nsc.org/research/odds.aspx
Greywater system permit compliance rate in California				
1,770,347	Greywater systems	2009	from above, extrapolation from 1999	(this assumes the proportion of greywater use has not chan
200	Permitted greywater systems	1992-2009	ReWater Systems, 70±, Bill Wilson + Kevin 20±, Ted Adams, 5± Art Ludwig, 2±…rest are a guess. I'd say lower bound is
8,852	Ratio of unpermitted to permitted systems		calculation	
0.011%	Percent of permitted systems		calculation	

Reportable GW Diseases, Potential & Reported	Total Cases		
Disease	in 2007	Est. 60 Years Cumulative Cases	Cases Linked to Graywater
Cholera	7	288	0
Cryptosporidiosis	11,170	502,650	0
E. coli, Shiga toxin-producing (STEC)	4,847	218,115	0
Giardiasis	19,417	873,765	0
Hepatitis A	2,979	134,055	0
Legionellosis	2,716	122,220	0
Salmonellosis	47,995	2,159,775	0
Shigellosis	19,758	889,110	0
Vibriosis (non-cholera Vibrio species infections) §	447	20,115	0
Totals	**123,713**	**4,920,093**	**0**

Graywater Treatment




Laundry
Bathroom
3-way valve
Vent
Screen
Overflow
Pump
Filter
Surge tank
To sewer
To subsurface drip irrigation

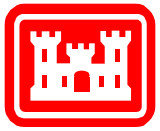


Using Graywater

- **Advantages**
  - Saves Water
  - Less Discharge
  - Less Energy and Chemical Use
  - Recovery of Nutrients
  - Reduction of Hydraulic Load to Existing Systems
- **Disadvantages**
  - More Costly
  - May Decrease Flow to Sewage Plant
  - Potential for Spreading Disease Through Human Contact if not Properly Handled or Treated
  - Damage to Soil Long-term?
  - Potential Odors in Surge or Storage Tanks

When to Use

- Best in New Construction
- Estimate Graywater Production
- Office –Probably Not
- Barracks – Potentially
- Cost-Effective? Water Restrictions?
- Determine Applications – End Use
- Separate Systems



Other Concerns

- Fixture Flushing
- Cooling Towers
- Irrigation

- Regulations – Constantly Evolving
- States Vary
- Plumbing Codes Vary
- Usually Use for Sub-surface or Drip Irrigation

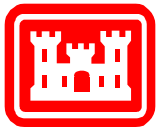
Graywater Reuse Opportunities

Systems

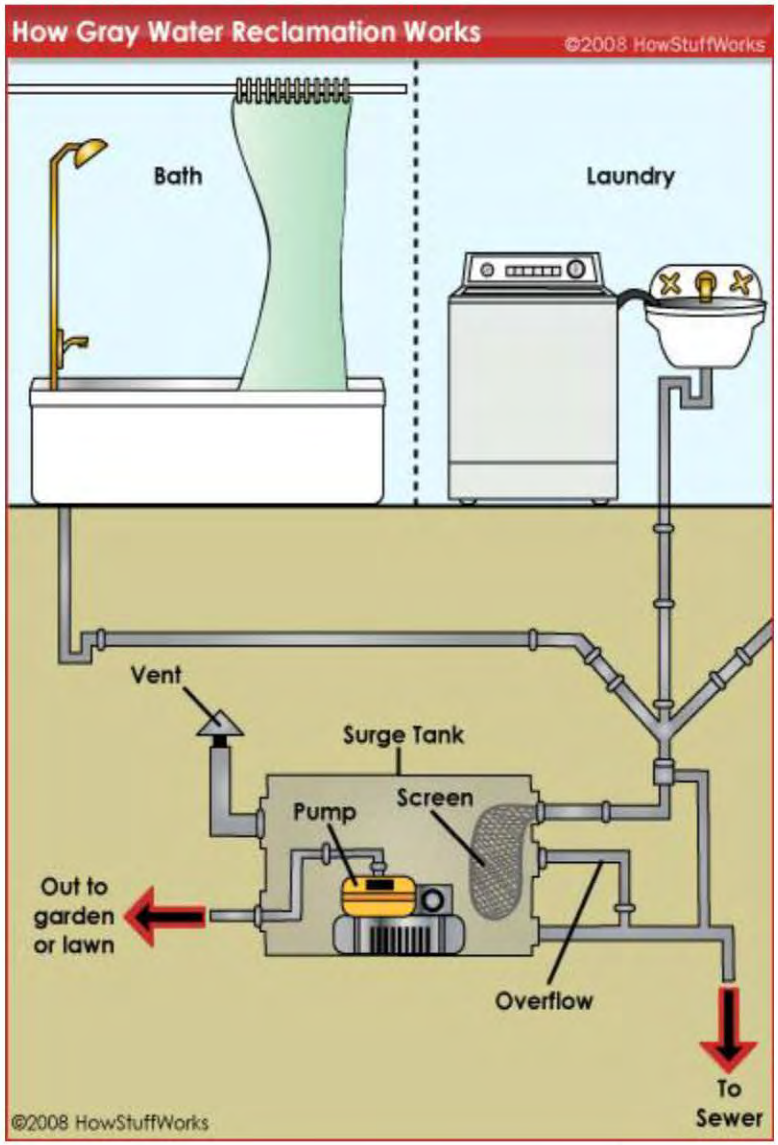
- AZ Regulations for Surface Application
  - Settling Tanks and Sand Filters
  - Sump Surge Tank
  - Filter Lint and Hair
  - Pump to Toilet or Landscape
  - State Review of Design and Construction
  - Settling or Holding Tank, Filtration, Disinfection if Applied to Surface Vegetation
  - Discourages Direct Discharge of Wash Machine to Outside Surface
  - Monitoring
- CA Requires Surge Tank, No Holding or Settling, Then Drip Irrigation
  - Local Control, Can Vary Requirements
- Other States Vary
  - Some Require Use of Separate Septic Tanks Before Use
- Changes Coming – Becoming More Liberal

Example

- Cochise County, AZ – “New residential construction shall have gray water lines plumbed to stub out, and be capped and clearly marked so as to permit the optional use of gray water by residents. The gray water plumbing must connect at least two plumbing fixtures, and preferably those that produce the most gray water without compromising the efficient evacuation of the black water pipes.”
- Applies to both single-family and multi-family and commercial projects.



Graywater Treatment



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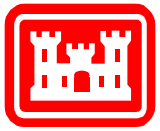
Future and Larger Scale Systems

- More Complex Operations
- Collect Large Quantities
- Blocks and Large Buildings have Dual Plumbing and Communal Systems with Treatment
- Combine with Other Sources Such as Rainwater



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Summary

- Numerous Drivers Promote Water Efficiency
- Graywater Use - One Option to Using Less Potable Water
- Graywater Quantities Can Be Significant
- Treatment Processes Variable
- Health Considerations Important
- Regulations Changing
- Match Water Quality with End Use
- U.S. Playing Catch-up
- New/Emerging Technologies Should be Demonstrated/Adopted
- PWTB to be Available Final Early FY 2010

Questions, Comments?

Also:
I would like your help!
Any information on graywater applications (planned or existing) at your installations or in your states would be greatly appreciated!
Also Rainwater Harvesting Applications.

Contact information or for additional information or resources

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217-398-5590